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Proliferation Path Assessment and Targeting System (PPATS)

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The Proliferation Path Assessment and Targeting System (PPATS) provides a common framework for conducting counterproliferation analysis. PPATS displays a network of acquisition pathways for nuclear, chemical and biological (NBC) weapons of mass destruction (WMD). The network display can be expanded to reveal individual process steps involving activities, equipment and materials. The PPATS software allows its users to link intelligence to the process steps, ascertain evidence of activity at certain steps and associate active steps installations/facilities. It allows analysts to determine critical paths based on findings of activity underway and assess the impact of potential options imposed against the proliferant country or actor. This report provides a general description of the prototype of software development effort and its status within the counterproliferation community.

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EXECUTIVE SUMMARY

The Proliferation Path Assessment and Targeting System (PPATS) is a joint Defense Special Weapons Agency (DSWA)/Defense Intelligence Agency (DIA) program. It is designed as an automated (human-in-the-loop) capability, specifically focused on path analysis of foreign acquisition programs for nuclear, biological and/or chemical (NBC) weapons. PPATS is intended to provide the core functionality of a counterproliferation workstation. The key functional capabilities of PPATS will allow a user to:

- Identify and track critical R&D, acquisition/production, and deployment steps constituting a country's or actor's proliferation path;
- Analyze generic susceptibilities (political, economic, and military) associated with critical elements or segments of the proliferation path; and
- Assess the impact of military actions against specific NBC facilities, including the potential for collateral effects resulting from the release and spread of nuclear materials, biological toxins, or chemical agents.

The key functions of PPATS will interface with additional intelligence analysis and mission planning capabilities to create an "operations qualified" workstation that all elements of the DoD can use to develop, to evaluate, and to select options to meet emerging proliferation threats. As such, PPATS, coupled with the complementary applications, will evolve to become a corporate Automated Data Processing (ADP) capability for:

- Assessing the activities of a proliferant country;
- Analyzing potential counterproliferation options; and
- Accessing the supporting information (finished intelligence displays and mission planning documents).

PPATS displays a network of acquisition pathways for each NBC discipline. The network display can be expanded at various segments along the pathways to reveal individual process steps involving activities, equipment, and materials. PPATS links intelligence to the process steps, generates attribute values based on the supporting evidence, and associates process steps with placenames, organizations, or facilities.

Analysts responsible for assessing proliferation threats posed by a particular country can use PPATS to establish a sanctioned file reflecting the current status of that country's NBC acquisition program. PPATS can display the attribute values for process steps along the pathways in a manner that reflects

the level of activity underway or the progress being made toward acquiring an NBC capability.

Attribute values for step intent can vary (from 0 to 5) along the pathways reflecting the supporting evidence of activity at any particular step in the process. Color coding the values allows a user to visually comprehend current status at the target system level while, at the same time, readily identify activities of particular concern.

Based on the supporting evidence for the sanctioned file or with user modified attribute values, PPATS allows analysts, decision-makers, and warfighters to perform proliferation path analyses. It identifies the critical path being pursued by a country and assesses the impact of political, economic, or military options invoked against the threatening activity.

DSWA began the development of PPATS to provide a common framework for conducting counterproliferation analysis. PPATS is still in its initial, three-year prototyping phase of software development begun in January 1995. The approach employed in the development of PPATS was to integrate, incorporate, or interface existing tools and data sources in a common, integrated workstation environment where users may access, directly or indirectly, all the tools necessary to fulfill the NBC counterproliferation mission. PPATS, as one primary capability residing on the integrated workstation, would be complemented by additional intelligence analysis, decision-making and warfighting applications that combine to provide key elements of the DoD with a robust, automated capability for developing, evaluating, and selecting options to deal with emerging or existing proliferation threats.

The design and development of the PPATS core functionality occurred incrementally. Functionality was added and modified according to feedback from user involvement in the development of PPATS. Several aspects of the functional design required close coordination with subject matter experts and consensus from the PPATS user community. The independent assessment and beta testing of prototype software provided constructive input from the intended users.

DIA participated as a joint sponsor of PPATS with management and analyst involvement from the beginning of the prototype development in January 1995. DIA personnel participated in the PPATS Users Group meetings, accompanied DSWA on visits to the combatant CINCs and the national laboratories, coordinated and assisted in the case studies, and conducted an evaluation of the beta version of the prototype software.

The evaluation of the beta version of the PPATS prototype software by DIA was accomplished in several sessions spanning January and February 1997. DIA reported the conclusions of their evaluation of the PPATS software to DSWA in March 1997. Their conclusion was "PPATS software will not enhance the production of counterproliferation intelligence." In subsequent discussions regarding their evaluation of PPATS, DIA underlined their principal objection to the prototype software as, "This is not how we do intelligence." DIA described their normal operational procedure as one which provides finished intelligence tailored to the customer's request for information.

In the same time period, the Deputy Assistant to the Secretary of Defense for Counterproliferation (DATSD(CP)) asked the Defense Evaluation Support Activity (DESA) to perform an independent and impartial assessment of the PPATS program and program direction. DESA found that the CP community has identified the need for a proliferation pathway analysis tool. Currently, they believe PPATS appears to be the only path analysis software program development which provides the capability to track each of the nuclear, biological, and chemical disciplines.

DESA determined the key issue for the PPATS program is that it does not have an explicit agreement with an executive agency to provide the necessary resources to support the fielding of the software application. However, that issue was separate from the capabilities of the prototype software and the status of the program development. Specifically, DESA stated PPATS is a promising development that will provide a unique and needed capability to the CP intelligence community. The PPATS as a software system appears to be progressing well in its development cycle. There do not appear to be any significant technical design obstacles to achieve Initial Operational Capability (IOC). Nevertheless, DESA recommended continued funding of the PPATS program, only if the operational requirements for path analysis at each echelon are clearly defined, and if DIA agrees to support the program as the executive agency.

DSWA initiated the PPATS program to support the entire CP community from the intelligence analyst to the decision-maker and the warfighter. From this viewpoint, the PPATS program is right on target. A valid requirement, even if not formally defined in detail at each echelon, exists for counterproliferation path analysis. The integration of PPATS into the daily routine of intelligence analysts at DIA can be managed to minimize the manpower drain. Admittedly, it will be a paradigm shift for DIA country analysts but the changeover does not have to be immediate and disruptive. Properly applied, PPATS could replace current procedures used by analysts to track and monitor proliferant countries.

CONVERSION TABLE

Conversion factors for U.S. customary to metric (SI) units of measurement

To Convert From	To	Multiply
angstrom	meters (m)	1.000 000 X E–10
atmosphere (normal)	kilo pascal (kPa)	1.013 25 X E+2
bara	kilo pascal (kPa)	1.000 000 X E+2
barn	meter^2 (m^2)	1.000 000 X E–28
British Thermal unit (thermochemical)	joule (J)	1.054 350 X E+3
calorie (thermochemical)	joule (J)	4.184 000
cal (thermocemical)/cm^2	mega joule/m^2(MJ/m^2)	4.184 000 X E–2
curie	giga becquerel (GBq)*	3.700 000 X E+1
degree (angle)	radian (rad)	1.745 329 X E–2
degree Fahrenheit	degree kelvin (K)	$^tK=(t^of + 459.67)/1.8$
electron volt	joule (J)	1.602 19 X E–19
erg	joule (J)	1.000 000 X E–7
erg/second	watt (W)	1.000 000 X E–7
foot	meter (m)	3.048 000 X E–1
foot–pound–force	joule (J)	1.355 818
gallon (U.S. liquid)	meter^3 (m^3)	3.785 412 X E–3
inch	meter (m)	2.540 000 X E–2
jerk	joule (J)	1.000 000 X E+9
joule/kilogram (J/Kg) (radiation dose absorbed)	Gray (Gy)	1.000 000
kilotons	terajoules	4.183
kip (1000 lbf)	newton (N)	4.448 222 X E+3
kip/inch^2 (ksi)	kilo pascal (kPa)	6.894 757 X E+3
ktap	newton–second/m^2 (N–s/m^2)	1.000 000 X E+2
micron	meter (m)	1.000 000 X E–6
mil	meter (m)	2.540 000 X E–5
mile (international)	meter (m)	1.609 344 X E+3
ounce	kilogram (kg)	2.834 952 X E–2
pound–force (lbf avoirdupois)	newton (N)	4.448 222
pound–force inch	newton–meter (N•m)	1.129 848 X E–1
pound–force/inch	newton/meter (N/m)	1.751 268 X E+2
pound–force/foot^2	kilo pascal (kPa)	4.788 026 X E–2
pound–force/inch^2 (psi)	kilo pascal (kPa)	6.894 757
pound–mass (lbm avoirdupois)	kilogram (kg)	4.535 924 X E–1
pound–mass–foot^2 (moment of inertia)	kilogram–meter^2 (kg•m^2)	4.214 011 X E–2
pound–mass/foot^3	kilogram/meter^3 (kg/m^3)	1.601 846 X E+1
rad (radiation dose absorbed)	Gray (Gy)**	1.000 000 X E–2
roentgen	coulomb/kilogram (C/kg)	2.579 760 X E–4
shake	second (s)	1.000 000 X E–8
slug	kilogram (kg)	1.459 390 X E+1
torr (mm Hg,0^{0}C)	kilo pascal (kPa)	1.333 22 X E–1

*The becquerel (Bq) is the SI unit of radioactivity; Bp = 1 event/s.
**The Gray (Gy) is the SI unit of absorbed radiation

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SECTION 1
INTRODUCTION

1.1 PROJECT BACKGROUND.

Countering the proliferation of weapons of mass destruction (WMD) -- nuclear, chemical, and biological (NBC) weapons, and their missile delivery systems -- is one of the U.S. Government's top defense-related issues. The dual-use nature of technology and materials associated with development of WMD makes their acquisition a critical goal of virtually any organization or state desiring such a capability. Monitoring and analyzing proliferation activities worldwide is of significant interest to the Government and the DoD is concerned with counter proliferation planning in an economically, politically, and militarily prudent fashion. To further this goal, the Defense Special Weapons Agency (DSWA) is developing the Proliferation Path Assessment and Targeting System (PPATS) counterproliferation analysis tool.

PPATS is a joint DSWA and Defense Intelligence Agency (DIA) project funded by the DoD Counter-initiative to help address several shortfalls identified in 1995 by the Counterproliferation Program Review Committee (CPRC). The committee identified among its highest priority shortfalls the need for:

- Country specific data to include technical paths for WMD development and supply relationships;
- Reliable methodology for detecting WMD programs early in their development; and,
- Target planning and protection capability.

PPATS is intended to provide the core functionality of a counterproliferation workstation. The key functional capabilities of PPATS will allow the user to:

- Identify and track critical R&D, acquisition/production, and deployment steps constituting a country's or actor's proliferation path;
- Analyze generic susceptibilities (political, economic and military) associated with critical elements or segments of the proliferation path; and,
- Assess the impact of military actions against specific NBC facilities, including the potential for collateral effects resulting from the release and spread of nuclear materials, biological toxins or chemical agents.

PPATS will be deployed on an integrated analytical workstation using a Sun Unix environment with an OSF/Motif graphical user interface (GUI). It will rely upon science and technology (S&T) nonproliferation and counterproliferation

data input from all-source intelligence such as will be available from the Defense Intelligence Threat Data Migration System (MDITDS). This information will be processed into sanctioned files and distributed world wide via DoD communication systems to users in the Washington, D.C. area, throughout CONUS and in overseas/theater locations. Selected information from PPATS may be exported to mission planning applications such as Rapid Application of Air Power (RAAP) and Integrated Munitions Effectiveness Analysis (IMEA). In this manner, PPATS provides a common framework for conducting counterproliferation analysis in a consistent, coordinated, and timely fashion.

1.2 PROJECT DOCUMENTATION.

1.2.1 Final Report. See 1.3 below.

1.2.2 Systems Requirements Document (SRD).

The SRD serves as a statement of understanding between the users of PPATS and the developers of the system.

1.2.3 Concept of Operations (CONOPS) Document.

The CONOPS Document outlines the fielding, use, and integration of PPATS within the counterproliferation community.

1.2.4 Functional Design Document (FDD).

The FDD provides a functional description and application software design for the core functionality of PPATS.

1.2.5 Software Users Manual.

The Software Users Manual is designed to assist hands-on software users of PPATS to effectively execute the functional applications of the system.

1.2.6 Software Developers Manual.

The Software Developers Manual contains information for software developers and system support personnel concerning the structure and functionality of the system.

1.3 THIS REPORT.

1.3.1 Scope.

This report provides a general description of the Proliferation Path Assessment and Targeting System (PPATS) program. It describes work accomplished on each task including system requirements, concept definition, functional design and software development. It documents the involvement of potential users in the evolution of the prototype software and presents recommendations for continued development. The report covers work accomplished from 20 December 1994 to 15 March 1997.

1.3.2 Structure.

A summary of the work performed provides an overview of the effort. The overview is followed by general descriptions of each of the major tasks accomplished. Some of the general descriptions are synopses of more detailed treatments in separate reports on the following topics: system requirements, concept of operations, and functional design.

The involvement of potential users, early on in the prototype software development, is highlighted in the report because user input was a key objective in the effort. The report closes out with general conclusions and recommendations.

1.3.3 Report Caveats.

This report describes a PPATS still in its initial rapid prototyping phase, not yet able to operate on a special compartmented information (SCI) local area net (LAN).

SECTION 2
SUMMARY OF WORK PERFORMED

2.1 OVERALL PROCESS.

The PPATS program is based on a rapid prototyping approach geared to providing intended users an early opportunity to guide the evolution of the prototype software toward a more useful product. A PPATS Users Group was established as a first order of business and became a sounding board for setting requirements, developing the concept of operations, and defining the functional design for the software. Initial versions of beta software were released ahead of normal timelines to allow some early feedback to begin as soon as possible.

2.2 PROJECT TASKS.

2.2.1 Program Management.

The program management of the PPATS effort focused on three distinct activities. First, the general aspects common to all software development projects; second, a PPATS Users Group; and third, support to independent assessments of the software.

The general aspects provided all the normal managerial and administrative support necessary to satisfy all specified requirements and complete all specified tasking. This included, in addition to the usual monthly reporting functions, an appropriate level of review and oversight, as well as the assessment and management of the risks associated with the project.

The rapid prototyping approach for PPATS depended on the establishment and involvement of a users group to act as an advisory committee to the PPATS development. The PPATS Users Group was established on 3 April 1995 and has met periodically throughout the duration of the effort. The Users Group served as a forum for:

- Maintaining community oversight;
- Establishing user needs and identifying pertinent data sources, existing software, and related systems;
- Reviewing, refining and coordinating system requirements, concept of operations, and functional design; and,
- Reaching consensus on issues encountered during the development of PPATS.

The independent assessment and beta testing of prototype software provided constructive input from the intended users. This external assessment and evaluation test was separate and distinct from the internal quality assurance and testing program. However, structured procedures were provided for the test personnel to follow with allowance for unstructured evaluation (free-play).

2.2.2 System Design Definition and Analysis.

The development of PPATS entailed a system design for an automated proliferation path model and targeting system based on directed graph tools provided by DSWA. The tools, Chemical Weapons Capability Acquisition Process (CWCAP) and Nuclear Capabilities Acquisition Process (NCAP), were stand-alone, personal computer (PC) based models with no automated data input or interface with external applications.

The PPATS design includes user-level and core-level functions, which interface with external data sources for intelligence input and "downstream" applications. The user-level functions consist of quality controlled data input for all source intelligence, path analysis, report generation, and external applications. The core functions derived from the directed graph tools (CWCAP and NCAP) allow the user to determine the current status, analyze critical paths, and assess option impacts. These functions interact according to the relationships defined by the top-level system design (see Figure 1-1).

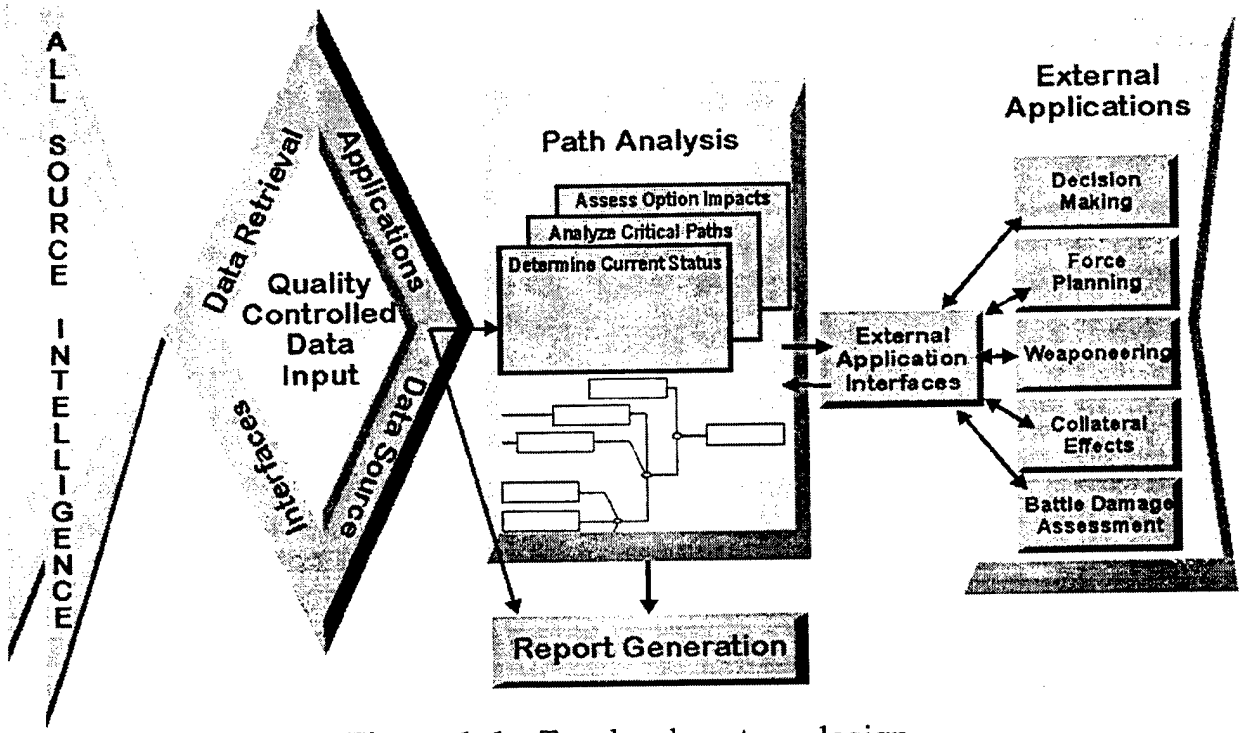

Figure 1-1. Top-level system design.

The all source intelligence input includes data feeds such as the MDITDS, Modernized Integration Data Base (MIDB) and national or theater message handling systems. The quality controlled data input uses lexicon terms reflecting the science behind the process pathways to query the all source intelligence to systematically identify, organize, store, and reference (with user approval) the supporting evidence of activity underway by a proliferating actor. The core functions allow the user to identify process steps and associated facilities, which could be susceptible to political, economic, or military options to impede, blunt, or deny the activities being pursued by the proliferant. PPATS can interface with existing mission planning tools and collateral effects models to provide information on candidate targets or accept damage estimates against specific installations for "what if" tradeoffs and analyses.

2.2.3 Functional Design.

The approach employed in the development of PPATS was to integrate, incorporate, or interface existing tools and data sources in a common, integrated workstation environment where users may access, directly or indirectly, all the tools necessary to fulfill the NBC counterproliferation mission. PPATS, as one primary capability residing on the integrated workstation, would be complemented by additional intelligence analysis, decision-making, and warfighting applications that combine to provide key elements of the DoD with a robust, automated capability for developing, evaluating, and selecting options to deal with emerging or existing proliferation threats.

PPATS incorporates the directed graph tools (CWCAP and NCAP) to accomplish the core functions imbedded in the more general path analysis. PPATS has directly integrated the Memex search engine for querying and the text extraction of Pathfinder for facility association. PPATS will establish interfaces to intelligence input sources (such as MDITDS and MIDB) and downstream applications (RAAP/IMEA).

PPATS, as a primary feature of the integrated workstation, provides general user functions applicable to all users (intelligence analysts, decision-makers, and warfighters):

- Path analysis (displays, current status, and critical paths);
- Access to supporting information; and
- Output to support publication of reports.

Special functions are provided to support particular requirements for each of the users. For instance, intelligence analysts have the primary interest in:

- Quality controlled data input and
- Generation of attribute values.

Decision-Makers are supported by:

- High level displays, and
- On-line report generation.

Warfighters are supported by:

- Option impact analysis, and
- Interfaces with external applications.

Although the special functions were intended to serve the special interests of the separate user types, in fact, any user may choose or need to exercise any function PPATS provides.

2.2.4 Hardware Acquisition and Integration.

The PPATS software runs on a Sun workstation with a Solaris 2.4 operating system and either OSF/Motif 1.2 or OpenWindows windowing environment. The following specific characteristics are recommended for hardware platforms:

- Sun SPARC Classic, 4, 5, 10, 20, or better.
- 32 MB RAM memory minimum (64 MB recommended).
- 1.05 GB hard disk memory (does not include disk space required for storing site-generated databases).
- 3.5 inch (88.9 mm) internal floppy disk drive (optional).
- Installation device, at least one of the following:
  - 150 MB .25 inch (6.35mm) QIC-150 tape drive, or
  - 5 GB 8 mm (.31 inch) tape drive.

A number of commercial-off-the-shelf (COTS) software products are used (not just interfaced with, but actually used in the system). Zinc Application Framework supports the GUI. The Memex Application Integration Library serves as the text search engine. Ctree Plus is used to provide a simple and efficient storage and retrieval mechanism for structured data. Also, OpenClient/C, a Sybase application is used to access the MIDB.

Additionally, Pathfinder, a Government-off-the-shelf (GOTS) software product, is used to create Memex databases external to the PPATS software. That is, it is not actually used in the system, but rather prepares data inputs to the system.

The PPATS software is written in C++ language and has approximately 75,000 lines of code.

The PPATS software and baseline data requires approximately 50 Mbytes of hard disk storage space. The full Pathfinder software suite requires approximately 400 Mbytes of storage space. However, this amount can be reduced to approximately 100 Mbytes if only the Generic Load functionality is installed.

2.2.5 Early Operational Capability (EOC) Implementation.

The EOC for PPATS was demonstrated 26 September 1995 during the fifth meeting of the PPATS Users Group. The technical demonstration represented a major step along the PPATS development pathway and showed the users, for the first time, evolving PPATS functionality, including the initial capability to perform critical path analysis. In all, the demonstration covered the implemented capabilities including:

- Determining current status of a proliferant actor;
- Quality-controlled data input;
- Assignment of attribute values for step intent;
- Accessing supporting intelligence (evidence);
- Critical path and step analyses; and
- Option impact assessment.

In demonstrating these capabilities, the users were shown the new GUI features including icons, pull down menus, and the set of notebook windows for each process step in the pathways. The users were also shown how an analyst can determine the current status of a proliferant actor by highlighting the process steps having a step intent above a threshold value.

The demonstration showed how a user can query a set of data to identify findings, associate those findings with process steps, and assign step intent values based on those findings. The demonstration also showed how a user can access the supporting evidence, i.e., the source intelligence documents that yielded the finding and, in turn, generated the values of step intent. Finally, the session demonstrated how the user may conduct path analyses by identifying the most critical path based on step intent and assessing the impact of interdiction of a critical process step along the critical path.

2.2.6 Initial Operational Capability (IOC) Implementation.

DSWA has defined the PPATS IOC as a prototype version that provides the following functionality to its users:

- Operational models:
  - Nuclear,
  - Chemical, and
  - biological (limited agents).
  -
- Functional attributes:
  - Step intent,
  - Time remaining,
  - Susceptibility, and
  - Hazard potential.
  -
- Established interfaces (flat file transfer only):
  - IMEA, and
  - RAAP.

The first beta version of the IOC prototype software was demonstrated to the Users Group on 13 November 1996. The technical demonstration focused on the new functionality implemented in the beta test version of the PPATS software.

The technical demonstration began by reviewing changes made in the displays of the pathways and the attribute values for individual process steps. New "landmark" labels were added to aid the user in locating significant milestones in the pathways. The attribute values assigned to process steps could be displayed by "color-coding" the elements of the pathways according to a spectrum of colors representing the range of values allowed.

The demonstration continued with an explanation on how the new functionality for three attributes (time to completion, time remaining, and susceptibility) had been implemented. The default values assigned to each attribute were pointed out and the background information available to make the default value selection was discussed. The explanation of the attributes concluded by showing how the susceptibility index has three sub-indices: political, economic, and military. All attribute values are subject to user acceptance and revision.

The demonstration also explained the new functionality implemented to assist the user in accepting or rejecting findings, the "global acceptance" procedures. PPATS recognizes when a particular finding is encountered at one or more

process steps. In such cases, PPATS allows the user to decide whether or not to accept the finding at any of the possible steps the first time it is encountered.

The session also demonstrated how facilities are identified and associated with various process steps. Using the text extraction functionality of the Pathfinder Generic Load capability, PPATS is able to identify facilities, which may be associated with specific process steps in the pathways. The user can then select from the suggested list those facilities, which should be associated to a particular process step. In addition, facility data can be exported to downstream applications for weaponeering and mission planning.

The Beta Test conducted by U.S. Central Command (USCENTCOM) personnel was the first evaluation of the IOC version of the software. The version of prototype software used in the Beta Test has all the IOC functionality except for the initial feasibility version of the biological model and the hazard potential attribute.

Once a decision on IOC is made, full operational capability (FOC) will be defined by DSWA/DIA. At a minimum, the FOC version will incorporate a biological model comparable to the nuclear and chemical models in the IOC version. Also, the FOC version will include throughput capacity as an additional attribute for path analysis. Of course, whenever possible, user suggestions for improvements to the software will be accommodated.

SECTION 3
SYSTEM REQUIREMENTS

3.1 OVERVIEW.

PPATS is intended for use by decision-making officials at all levels, by NBC weapon systems intelligence analysts, and by theater force planning level warfighters, including operations, plans, combat targeting and intelligence personnel. General requirements common to all users are complemented by specific user requirements for each of the three categories of users: decision-makers, intelligence analysts, and warfighters. Also, three categories of system requirements (processing, data handling, and security) support the mission-oriented requirements.

PPATS' goal is to integrate, incorporate, or interface existing tools and data sources in a common workstation environment. PPATS will capitalize on existing systems and network components to fulfill this goal. The prototype system will be based on an open systems concept supporting the interconnection and interoperability of complementary workstation functions and external applications.

3.2 SYSTEM REQUIREMENTS DOCUMENT (SRD).

The SRD serves as a statement of understanding between the users of PPATS and the developers of the system. PPATS is an automated (human-in-the-loop) capability specifically focused on path analysis of foreign acquisition programs for NBC weapon systems. The key functions of PPATS are complemented by additional intelligence analysis and mission planning capabilities which combine to create an operations qualified workstation suitable for all elements of the DoD to use to develop, to evaluate, and to select options to deal with emerging or existing counterproliferation threats.

The SRD is a separate deliverable in the set of PPATS program documentation.

SECTION 4
CONCEPT OF OPERATIONS

4.1 OVERVIEW.

PPATS is designed as an automated (human-in-the-loop) capability specifically focused on proliferation path analysis of foreign acquisition and production programs for NBC weapons. PPATS will be deployed as an integrated analytical workstation using a Sun Unix environment and is intended to serve as the counterproliferation workstation for the DoD. It is a networked and robust decision-making, analytical, and operational target planning and force execution support tool. PPATS is designed to reside at the national level, in unified commands, in Service staffs, at the force level, and in support of Joint Task Forces (JTFs) and other deployed forces.

PPATS features a variety of types and classes of functional utility, is applicable across a broad spectrum of counterproliferation options, and has a central role as the hub of the DoD's NBC counterproliferation decision-making, analysis, and operational planning/execution support. PPATS can be employed to assist in decision-making, analysis, and warfighting activities. PPATS can take raw intelligence, focus it, correlate it to proliferation path networks, use the focused intelligence to assign attribute values to network elements, and translate the reduced intelligence into processed information in the form of network analysis outputs. Continuing, PPATS can employ processed information in national policy options development and ultimately, mate it with relevant operational data and apply the combined information in support of the operational problem.

4.2 CONCEPT OF OPERATIONS (CONOPS) DOCUMENT.

The CONOPS Document outlines the fielding, use, and integration of PPATS within the counterproliferation community. It addresses integration into the DoD and other national agency, analytic, decision-making, operational planning, and force execution activities related to countering the proliferation of NBC weapons. The document provides a full discussion of anticipated PPATS functionalities and offers an opportunity for users to constructively critique and refine PPATS' overall direction and specific capabilities.

The first part of the document provides a description of PPATS and a discussion of its functionalities, data handling, and processing. It illustrates how PPATS will be integrated with existing, or anticipated, analytic and operational warfighting applications. This part of the CONOPS also discusses

the three primary groups of anticipated users: decision-makers, NBC intelligence analysts, and warfighters. It shows how tailored versions of PPATS will support and facilitate meeting the closely related, but distinctive, needs for counterproliferation analysis for each of the groups.

To illustrate the functionality and utility of PPATS, the second part of the document consists of a case study of an NBC weapon proliferation scenario based on the notional country of Satyra, and its quest to develop and field a missile-delivered chemical warhead -- their first chemical weapon. This case study shows how PPATS can be used by the three groups of users to help in their distinctive tasks and missions related to NBC weapon proliferation.

Additionally, the document contains three appendices, each outlining how PPATS would function, as a primary application for NBC intelligence analysts, decision-makers, and warfighters.

The CONOPS Document is a separate deliverable in the set of PPATS program documentation.

SECTION 5
FUNCTIONAL DESIGN

5.1 OVERVIEW.

PPATS displays a network of acquisition pathways for each NBC discipline. The network display can be expanded at various segments along the pathways to reveal individual process steps involving activities, equipment, and materials. PPATS links intelligence to the process steps, generates attribute values based on the supporting evidence of activity at specific process steps, and associates such process steps with place names, organizations, or facilities.

Analysts responsible for assessing proliferation threats posed by a particular country can use PPATS to establish a sanctioned file reflecting the current status of that country's NBC acquisition program. PPATS can display the attribute values for process steps along the pathways in a manner that reflects the level of activity underway or the progress being made toward acquiring an NBC capability.

Based on the supporting evidence for the sanctioned file or with user modified attribute values, PPATS allows analysts, decision-makers, and warfighters to perform proliferation path analyses. It identifies the critical path being pursued by a country and assesses the impact of political, economic, or military options invoked against the threatening activity.

5.2 FUNCTIONAL DESCRIPTIONS.

5.2.1 System Displays.

5.2.1.1 Network Layout Displays. PPATS displays a network of pathways representing all the technology (nuclear science, chemistry, and biology) and requirements involved in the acquisition of WMD. These pathways are based on established or theoretical routes and resemble process flow diagrams. The building blocks of the pathways consist of specific process steps or items representing an input or activity which can not be further expanded in detail. These elemental components of the pathways are connected in a manner to accurately represent the acquisition process, at a system level, as opposed to a very detailed engineering level.

The process steps or items are combined into pathways by means of three fundamental constructs: AND node, OR nodes, and SEQuences. An AND node

is a point along the pathway where all subsidiary component elements are required for the next step. An OR node is a point along the pathway where only one of two or more subsidiary component element is required for the next step. A SEQuence is an element followed by one or more items wherein each component must be completed in specific order of occurrence.

PPATS allows the user to display the entire network or sectors of the network in configurations called layouts. Each NBC discipline has a basic STARTUP layout (see Figure 5-1). The STARTUP layout can be manipulated (expanded, unlayered, or contracted) to create other layouts (particular configurations of pathway elements the user desires to display).

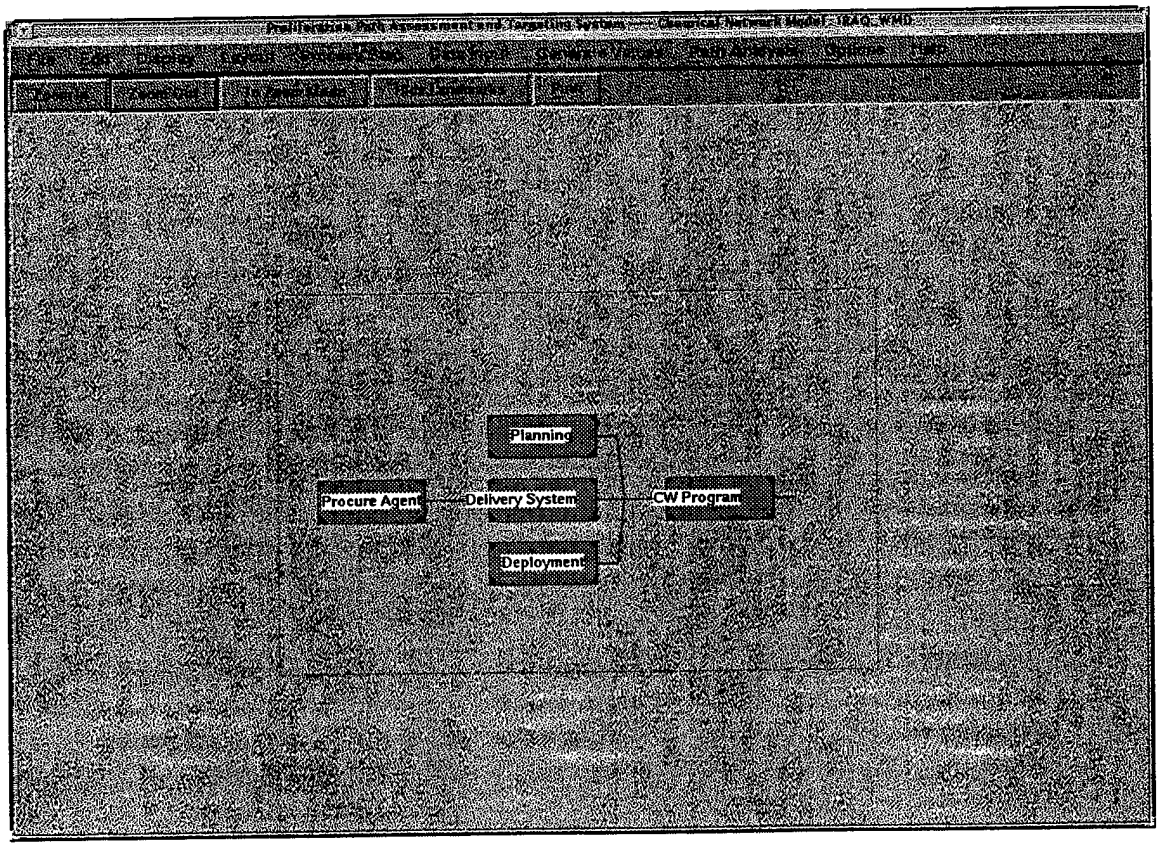

Figure 5-1. Startup layout.

5.2.1.2 Attribute Value Displays. PPATS relies on a number of attributes assigned to each process step to assess the current status of a proliferant and to perform path analysis of that proliferant's NBC capability acquisition program. The attributes include: uniqueness, step intent, time to completion, time remaining, and susceptibility.

Uniqueness, scaled from 0 to 5, represents an expert judgment about how specialized an item is to the accomplishment of the next (its parent) segment or milestone. A value of 0 means the item has many alternative uses; a value of 5 means the item has no known alternative use and is completely unique.

Step intent, scaled from 0 to 5, reflects the expert judgment of the likelihood an item is underway. A value of 5 means virtual certainty the step is underway. However, step intent does not indicate whether the item is intended for WMD alone, but simply that the item is underway at all.

Time to completion (TTOC) indicates the estimated time in months to proceed from start to finish to acquire an input or construct a facility. If the step is production-related, the TTOC value assumes necessary inputs (physical requirements and personnel) are available. If the step is material or equipment acquisition, TTOC represents the number of months to import or produce (domestically) the material or equipment.

Time remaining (TREM) represents the estimated range in time for an element to be completed. PPATS allows the user to specify a 90 percent confidence interval (maximum and minimum) in months measured with respect to a reference start date.

Susceptibility is the expert judgment of the likelihood an item or segment could be impeded or halted using political, economic, or military action. The susceptibility index itself does not specify how much the activity would be impeded, but rather the probability of having an effect of some kind. PPATS allows the user to specify changes in step intent and TREM resulting from successful execution of the political, economic, or military action.

Hazard potential and throughput capacity are two attributes not yet fully implemented in PPATS.

Hazard potential represents a judgment of the likelihood for unwanted collateral effects if an item or segment is subjected to physical damage from a military attack. PPATS allows the user to specify the potential for unwanted collateral effects as a high-level index ranging from 0 to 5 (minimum to maximum) based on the possibility for release of hazardous materials and the population density in the surrounding area. Throughput capacity represents

the estimated rate of nominal weapon material throughput for an item in the proliferation path.

PPATS provides the user with a number of ways to visually display the values of attributes assigned to each process step. For instance, the Attribute Filter identifies all elements within the network that meet a numerical threshold for the value of the attribute. It filters (color codes) the process steps meeting the criterion set by the user. The Display Range feature identifies process steps in various ranges of values by displaying them using a specific color in their respective boxes. A spectrum of colors and their corresponding value ranges are displayed in a band across the network window. The Configure Mouse Scan option using the right mouse button allows the user to interrogate each item to display selected attribute values. The resulting banner can be configured to display not only the item name, but the attribute values for that item as well.

5.2.1.3 Critical Path Displays. One of PPATS' most useful features is its ability to display critical paths based on attribute values assigned to process steps along the pathways. Critical paths may be displayed for any milestone in the network of pathways. The location of the selected critical path is displayed in the Network Window by bright red highlighting of all elements, nodes, and segment links involved (see Figure 5-2).

5.2.1.4 Notebook Displays. The Notebook is a key information management feature in PPATS. It is a convenient collection of the principal data sets used in PPATS. It consists of a series of windows portraying information related to each process step. The windows include: Attribute Values, Findings (step intent), Temporal Findings (time remaining), Source Documents, Facilities, Lexicon Terms, and a Notes Page.

5.2.2 System Setup.

5.2.2.1 Scenario File Options. PPATS allows the user to select (or create) one or more scenario files for any one country or actor. The Open Scenario File option permits the user to examine (or establish) two or more scenarios in a comparative mode. Additionally, the Edit Country Aliases option, allows the user to define aliases for each country name (e.g., Great Britain, UK, England, etc.) to be used in any query option exercised against input data to the particular scenario file.

5.2.2.2 Attribute Value Edits. Default values, representing guidelines based on common knowledge in a technical discipline, are provided by PPATS for each of the attributes at each process step (item). Findings obtained from

queries against input intelligence data (e.g., message traffic) and accepted by the user will generate step intent values in accordance with rule-based algorithms in PPATS. Attribute values for step intent and TREM at individual process steps are aggregated to provide values at AND nodes, OR nodes, and SEQuence nodes.

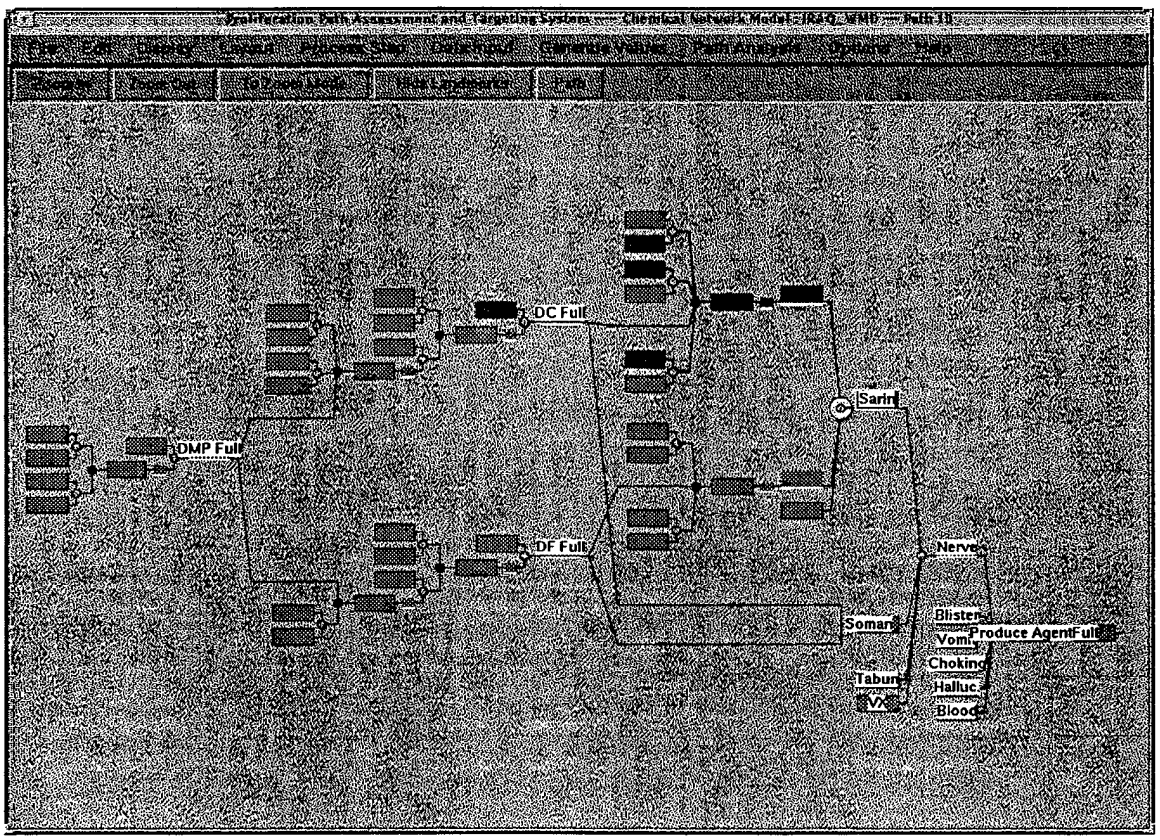

Figure 5-2. Critical path.

All of the attribute values (default, generated, or aggregated) can be modified by the user, as appropriate, for the particular scenario involved. Editing of attribute values is accomplished by using the Attribute Window. An audit trail of changes made to each attribute value is maintained in the Justification Panel of the Attribute Window.

5.2.2.3 Lexicon Edits. Lexicon terms describing the nature of each process step in each NBC network of pathways are used in queries against input intelligence data (e.g., message traffic) to identify findings (supporting evidence of activity at a particular process step). Each process step has a set of topical (generic) lexicon terms: items (equipment, materials, personnel types),

activities, and facilities. Also, a limited number of general lexicon terms with broad definitions (e.g., nuclear weapons, chemical agent, biological toxin) are defined for the top-level milestones in each NBC discipline. In addition to the generic lexicon terms, each step may have country specific terms: place names (installations), organizations, and individuals by name.

The user may add, delete, or modify any of the generic lexicon terms as may be required for each NBC discipline and any of the country specific terms according to the particular country involved. Editing of lexicon terms is accomplished by using the Lexicon Window.

5.2.2.4 Query Options. PPATS allows the user to initiate a query from any milestone along the network of pathways. A simple query would involve all the lexicon terms of all the child elements in the selected milestone's family. If a milestone's family includes another milestone as a child element (as most families do), the child element milestone contributes a few significant lexicon terms (called related terms) reflecting the nature of its family to the parent milestone's collection of terms.

As an alternative, PPATS allows the user to initiate a batch query from any milestone which has subsequent milestones along the way to the tail of the network. In this case, the related terms are not needed to adequately cover all the significant aspects of the milestone families involved.

In either a simple or batch query, the use of general terms is an option the user can elect by setting an environment variable as part of the workstation procedures for launching PPATS or by setting options in the Query Options Window.

5.2.3 Analytical Operations.

5.2.3.1 Query Results Analysis. After a simple query is initiated for just one milestone's family, the resulting documents containing potential findings for the child elements to that milestone can be analyzed by accessing them from the Query Results window. Source documents are defaulted to "Nominated" status after a simple query. A user may choose to eliminate a document from consideration based on its source or some other aspect of the information presented in the window.

When the user is satisfied that the source documents are acceptable, findings can be generated by PPATS and assigned to the appropriate process steps in the family.

5.2.3.2 Generating Findings. After the source documents have been accepted from a simple query, findings are generated by PPATS and assigned to the appropriate process steps in the family at the direction of the user. The user can ascertain which steps have findings by using the filtering feature for step intent findings.

In the case of a batch query, findings can be automatically generated by PPATS as the query steps through each of the milestone families. Again, after the query is finished, the user can identify the steps with findings by using the filtering feature.

The user can examine each finding at a process step by accessing the All Findings or Terms from Findings Windows for that particular step. If the finding is shared by one or more other steps, the user can invoke the global acceptance procedure to assure the finding is dealt with as soon as it is encountered. In this manner, the user is able to make a single, consistent decision (acceptance or rejection for each step sharing the potential finding) on a particular finding regardless of how many times it would have been encountered.

Most findings will be generated from a single term and, in many cases, a term which occurs frequently in the message traffic will lead to the build-up of several findings based on that single term. PPATS allow the user to register the most significant finding for any term. The software has criteria (rankings, quality, and activity date) upon which it recommends findings for registration to the user. The user can accept, reject, or select another finding for registration. The software keeps track of registration actions by an audit trail of current and previously registered findings. The software can then be instructed to only display registered findings. Registration is one means by which an analyst can cull out the most important findings to present to decision-makers or other users.

5.2.3.3 Generate Attribute Values. PPATS has established rule-based algorithms to assign Step Intent values to process steps based on the accepted findings at that step. The rule-based algorithms use the weights assigned to the lexicon terms in the findings to automatically calculate the step intent in a range form 0 to 3.00. The weights assigned to the lexicon terms are 1.0 for a weak indicator, 2.0 for a medium indicator, and 3.0 for a strong indicator. As stated before, these assigned values can be accepted or modified by the user. In order for step intent to rate a value between 3.00 and 5.00, the user must accept the finding as an observable or enter the desired number as an indication of a personal judgment as to the likelihood of activity underway at that specific process step. An observable is a finding which contains more

than one lexicon term and has the context of a more positive statement of activity at that step, e.g., an activity involving a specific material and/or equipment is underway at a particular location.

Whenever a new finding is accepted at a process step, the user can have PPATS generate the step intent value based on that finding and any other already accepted findings. The user can approve the new value, retain the old value, or enter a personal judgment value as appropriate.

Based on temporal findings, the user may chose to enter appropriate values for TREM parameters (maximum, minimum, and reference date). Assignment of TREM parameters is not yet automated.

The other attributes, uniqueness, TTOC, and susceptibility, are all set at default values by PPATS and manually modified by the user to properly reflect the scenario at hand.

5.2.3.4 Facility Association. PPATS relies on the Pathfinder Text Extraction function invoked in the preprocessing of the Memex data files used in the queries, to identify potential facilities for association to the individual process steps. PPATS allows the user to determine which of the proposed facilities should be associated with which process step or rejected for all steps. PPATS also provides a means for the user to add the facility place name to the country specific lexicon. The user can also add a facility association to any process step.

5.2.3.5 Current Status Options. The supporting evidence as reflected in the Step Intent and TREM attributes provides an information base which indicates the current status of a proliferant's WMD capability acquisition program. The Display Range feature of the Attributes option provides a convenient means to show the current status of a proliferant's program in terms of step intent or TREM. For either attribute, the range of values are displayed as a spectrum of colors in the boxes depicting the process steps. Additionally, other Display options and the Configure Mouse Scan are available to provide alternative visualizations of the current status.

5.2.3.6 Critical Path Options. Critical paths based on step intent or TREM may be displayed for any milestone in the network of pathways. The location of a critical path is determined by the aggregated value of either step intent or TREM taking in to account all possible paths to a particular milestone. The Path Window allows the user to select critical paths ranked either by highest to lowest step intent or by shortest to longest TREM for completion of the milestone segment. Additionally, the user can interrogate the Path Detail

Window to determine the elements constituting the path selected. Moreover, PPATS allows the user to identify the process step in the critical path with the greatest value for susceptibility (so-called target, which might be the process step itself, or a facility associated with the step) to potential political, economic, or military actions.

5.2.3.7 Impact Assessment. PPATS allows the user to assess the impact of potential political, economic, or military actions action against specific process steps in the critical path. The so-called target or any other step in the critical path can be excluded to assess the impact of removing that step from the path. After exclusion of the selected step, PPATS displays the next highest rank critical path which does not contain the excluded step, thereby identifying the most likely remaining technology option to be pursued by the proliferant. Additionally, PPATS can exclude all import steps from the critical path calculations.

5.2.4 System Output.

5.2.4.1 Facility Data Export. PPATS maintains (when available) a minimum, but essential, set of data on each facility associated with any process step. Currently, a facility without a place name can not be associated to a process step. If the accompanying data (category, function, coordinates, and BE number) are available from an installation database, PPATS can store the information in the Facilities Window. If the user decides a particular facility should be nominated as a potential target for further analysis or mission planning, PPATS can export the minimum set of data to a downstream application, such as RAAP.

5.2.4.2 Report Generation Support. PPATS supports report generation and ad-hoc documentation with a dedicated output capability and a general copy and paste functionality shared with the host workstation. The dedicated output function will allow the user to send data to a printer or file as determined by the workstation level directories or printer options. This function is provided for Attribute Values, Findings, Temporal Findings, Source Documents, Facilities, and Notes. Also, the text from Findings and Justifications can be copied and pasted into the PPATS Notes Page or any external text file/word processor feature on the workstation. In addition to these textual output features, pathway displays (and other window displays) can be captured and processed into external documents by using the Snapshot utility of the Unix workstation.

5.3 FUNCTIONAL DESIGN DOCUMENT (FDD).

The FDD is a separate deliverable in the set of PPATS program documentation.

SECTION 6
PROTOTYPE DEVELOPMENT

6.1 OVERVIEW.

The approach pursued in the development of the prototype encompassed several stages of evolution of the PPATS software. The path models were ported from the PC versions to run on the Sun Unix platforms. An automated mechanism for loading intelligence into PPATS had to be created from scratch. Once loaded, the intelligence input and pathway-specific parameters need to be accessed, merged, and managed in order to carry out the requisite information processing events. To improve user friendliness, several features in the original software needed to be revised and expanded to provide increased functionality. The establishment of a parameter file to complement the existing template file allowed for the efficient population of the pathways with lexicon terms and default values for attribute values. The methods by which finding were identified, nominated, and accepted evolved over time. Likewise, the association of facilities with specific process steps changed as more experience was gained regarding the system. Finally, but just as important, interfaces needed to be constructed to service downstream applications with PPATS generated information.

Some of these stages were sequential, while others overlapped or were accomplished on a concurrent basis in order to support the rapid prototyping mode of development. The software has evolved to an architecture as reflected in Figure 6-1.

6.2 RE-HOST ORIGINAL PATH MODELS.

DSWA and DIA identified the existing path models and other software packages pertinent to PPATS. The CWCAP and the NCAP software were provided as PC (DOS/Windows) applications. The Biochemical Capabilities Assessment Model (BCAM) was a Macintosh spread sheet application. Source code and some documentation were available for CWCAP and NCAP, but not for BCAM.

Apparently, the development of NCAP was terminated before its Country File Handler was completed or delivered. This deficiency and related routines, which did not transfer complete functionality upon re-hosting, caused some progress delays early on in this effort. These delays were compounded by a lack of detailed documentation and errors in the original software. These problems were addressed with increased intensity and overcome without significant delay. The re-hosting of the path models to the Unix platforms

culminated with the replacement of Windows-specific code with OSF/Motif compliant software.

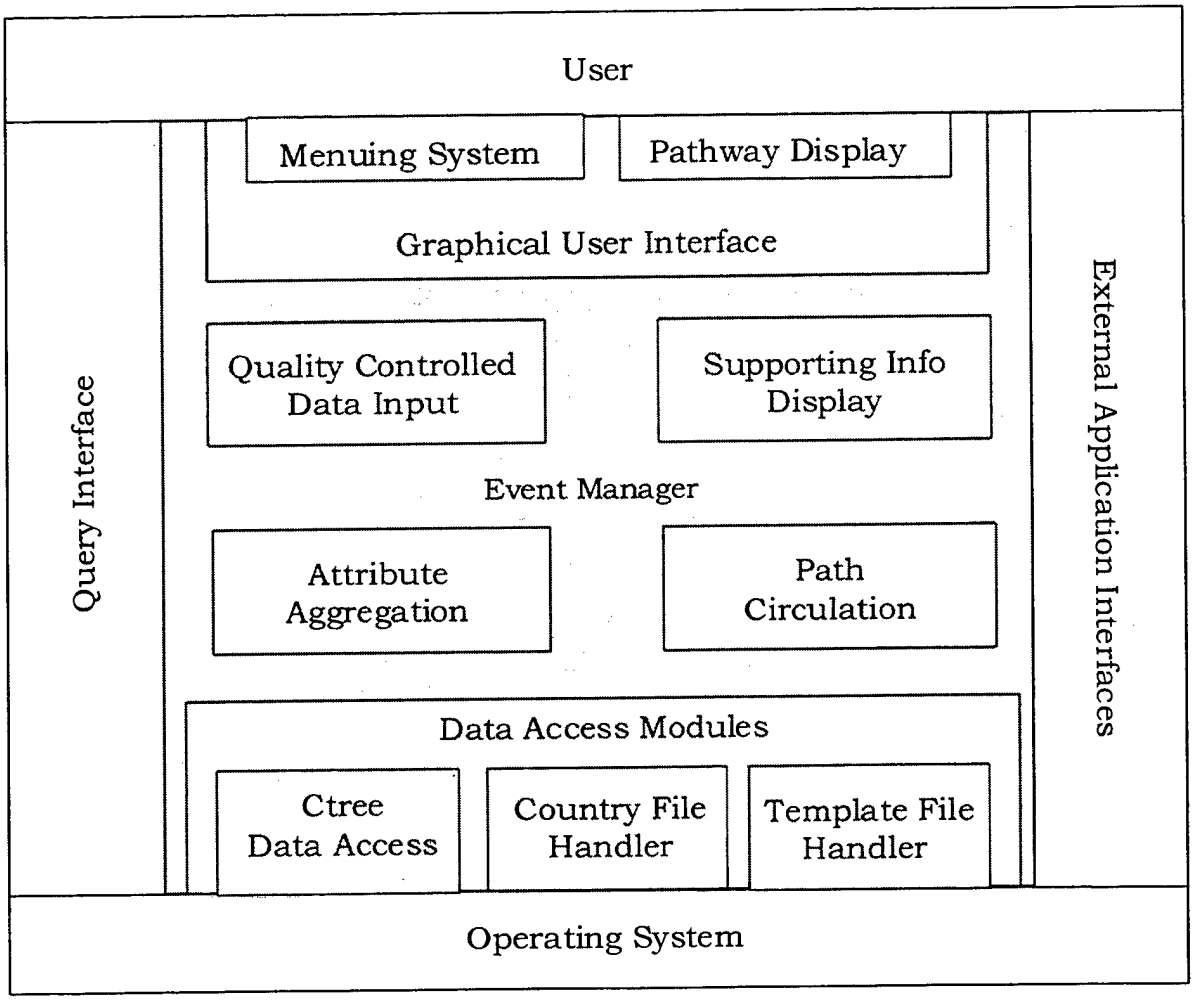

Figure 6-1. PPATS software architecture.

6.3 BUILD QUERY INTERFACE.

The most critical functionality developed for PPATS was the automated (user-in-the-loop) mechanism for intelligence input. The PPATS design relies on intelligence input in the form of Memex databases. Memex is a text search engine employed in the Pathfinder data retrieval and analysis program. Pathfinder, developed by Presearch, Inc. for the DIA, is used throughout the Intelligence Community. Additionally, the MDITDS will provide processed message traffic output in the form of Memex databases.

The intelligence input design for PPATS had to be flexible and versatile. Simply relying on the eventual capability of MDITDS is not acceptable. Until MDITDS is operational, or whenever other message feeds are to be input to PPATS, the Generic Load function of Pathfinder is used to preprocess ordinary message traffic in ASCII files into Memex databases.

PPATS interacts directly with the Memex search engine via an application program interface (API). A lexicon of technical (nuclear, chemical, or biological) proliferation terminology allows PPATS to formulate the appropriate queries for Memex to use in its data retrieval functions. Text extracted from messages identified by the Memex queries (findings) are processed by PPATS as indicators or observables related to activity at a particular process step in the proliferation pathway.

Additionally, in support of the associated facility functionality of PPATS, the design of the PPATS interface to the MIDB has been completed. The interface will allow PPATS users to query the MIDB to obtain a minimum essential set of installation data elements (if they exist) for a facility involved in the WMD acquisition program of a proliferant country.

6.4 BUILD DATA ACCESS MODULES.

Internal to PPATS, the intelligence input and pathway specific parameters must be stored for efficient and prompt recall in support of information processing events central to the core functionalities of the prototype software. The intelligence input processed by the Quality Control Data Input functions produce several forms of data which are stored in indexed files by the Ctree Data Access module. In order to support the functions of Supporting Information Display, Attribute Aggregation, and Path Calculation, the input data is merged and manipulated in conjunction with the pathway specific information by the Country File Handler and the Template File Handler.

The Country File and Template File functionalities existed previously, but needed to be revised to account for new or expanded attributes and the automated input of intelligence information, particularly the generation of findings based on the intelligence input.

6.5 RESTRUCTURE CORE SOFTWARE.

Besides providing an automated loading of intelligence throughout the proliferation pathways, PPATS is designed to allow the user to analyze the significance of the information assigned to individual steps as well as the "global" view across the entire network of pathways. The core software design

has been extended beyond the original functionalities of attribute aggregation and path calculation. This design involved the revision and expansion of several features in the original software to provide increased functionality.

Two major initiatives were pursued to provide the increased functionality for the quality controlled data input:

- The automatic generation of attribute values (for Step Intent) based on the findings, and
- New or expanded attributes.

A rule based system, which allows the significance of the lexicon term generating the finding to determine what numerical value to assign to the step intent attribute, has been implemented. The automatically generated value, along with a justification statement presenting the rationale, is presented to the user for review and approval.

Two new attributes were defined: throughput capacity and hazard potential. Throughput capacity is an estimated rate of weapon material flow through a process step. Hazard potential is an expert judgment of the likelihood of unwanted collateral effects accompanying any physical action (generally, military) taken against a process step. The susceptibility attribute has been expanded to consider three modes (political, economic, or military) of options, which could be invoked to disrupt, blunt, or deny progress in a proliferant's WMD program. The susceptibility attribute functionality also includes option impact information for changes in step intent and time remaining.

Providing a visual display of the significance of the intelligence input and the resulting changes in attribute values along the pathways was an important PPATS design goal. The original display features have been extended to provide visualization of information on source documents, findings, and facilities. Another improvement allows up to six ranges in values of attributes to be displayed in separate colors for better visualization.

6.6 ESTABLISH PARAMETER FILE.

The lexicon terms and rationale supporting default values for attributes are essential to the automatic generation of findings and rule based assignment of attribute values. In order to efficiently and effectively support those functionalities, a process parameter file concept was conceived, developed, and implemented in PPATS. The Process Parameter Files (PPFs) provide the principal input vehicle for listing the lexicon terms to be used at each process step in the pathways. Also, the beta software includes nuclear and chemical

models, each with their respective PPFs populated with the default values required by the attributes functional in this version: uniqueness, step intent, time to completion, time remaining, and susceptibility.

6.7 EVOLVE PROCESSING OF FINDINGS.

With the above noted basic functionality, PPATS is able to identify and nominate findings for the user to accept or reject. As the prototype software took form and experience was gained in processing real intelligence feed material, it became apparent that the initial procedures could and should be improved. For example, many lexicon terms, both topical and country specific occur at different process steps located throughout the pathways. As a result, a finding may recur throughout the pathways, leading to multiple encounters, each requiring decisions on acceptance or rejection. A "global" acceptance procedure was developed and implemented to deal with a finding assigned to more than one process step the first time it is encountered.

Other enhancements to the processing of findings have been identified and implemented during the development of the PPATS prototype software. An improved text extraction routine was developed for selecting and displaying findings for user review and approval. The improved approach prevents the anomalous retrieval of extraneous word phrases not connected with the actual finding. Also, relevance ranking is used to order both the documents retrieved and the findings generated in lists reflecting how germane each one is relative to the query used. A similar ranking algorithm is used to aid the user by indicating how strongly a particular finding is correlated to each of process steps it is assigned to.

6.8 ASSOCIATE FACILITIES.

The association of facilities with specific process steps functionality changed as more experience was gained. The text extraction feature provided with the Generic Load function of Pathfinder is used to identify facilities or placenames in the source documents. PPATS uses this function to nominate facilities to the user in a fashion similar to the nomination of findings. Software was developed to enable the association of installation data to specific process steps. New GUIs were established for the overlay of installation data and MIDB queries have been established to retrieve installation data elements potentially useful to downstream mission planning applications.

6.9 BUILD EXTERNAL APPLICATION INTERFACES.

Finally, but just as important, interfaces needed to be constructed to service downstream applications with PPATS generated information. Specifically, a flat-file data transfer mechanism has been designed for the interface between PPATS and the RAAP mission planning application.

SECTION 7
USER FEEDBACK

7.1 BACKGROUND.

The design and development of the PPATS core functionality occurred incrementally. Functionality was added and modified according to feedback from user involvement in the development of PPATS. Several aspects of the functional design required close coordination with subject matter experts and consensus from the PPATS user community.

The PPATS user community consists of individuals acting as:

- Intelligence analysts,
- Decision-makers, and
- Warfighters; and

In organizations such as:

- OSD,
- Joint Staff,
- Combatant commands/components, and
- DoD agencies.

The user coordination of PPATS development is complicated by the necessity to provide different levels of detail to different users at different locations. In particular, intelligence analysts must have access to all the detailed information, such as:

- Detailed pathways involving all process steps;
- All findings and associated source documents; and
- Access to such details at national and theater locations.

Decision-makers, on the other hand, may want only to skim the cream of the intelligence for the big picture. Their interests may be served by:

- Top level pathways showing source documents;
- Registered findings and key source documents; and
- WMD installations nominated for counterproliferation options.

Warfighters, most likely, will focus in on what is important for targeting. For instance, they are most interested in:

- Facility data overlaid on the pathways;
- Findings and source documents identifying the "threat" activities underway at WMD installations; and
- Rationale for nominating installations as potential targets for counterproliferation options.

Even with their differing interests, PPATS provides a common framework for its intended users. The common framework provides a consistent baseline for analysis by all types of users. The baseline data (sanctioned file) can be used as the standard for comparing excursions, sensitivity studies, or theater specific situations.

7.2 USERS GROUP.

A PPATS Users Group was established as a first order of business and became a sounding board for setting requirements, developing the concept of operations, and defining the functional design for the software. The Users Group served as a forum for:

- Maintaining community oversight;
- Establishing user needs and identifying pertinent data sources, existing software, and related systems;
- Reviewing, refining, and coordinating system requirements, concept of operations, and functional design; and,
- Reaching consensus on issues encountered during the development of PPATS.

The PPATS Users Group is chaired by DSWA and its membership consists of:

- OSDTUSD (P)/PS/IP
- OASD/ISP/CP/CA&R
- OATSD/AE (NCB)
- OATSD (SO/LIC)
- JCS J2T
- JCS J5/NucDiv
- JCS J8
- SAF/AQQS
- HQ USAF XOXI
- HQ DA ODCSOPS
- HQ DA ODCSINT
- CNO (N514)
- USACOM
- USCENTCOM

- USEUCOM
- USPACOM
- USSOCOM
- USSPACECOM
- USSTRATCOM
- JWAC
- DISA/JIEO
- AFSAA
- SWC/AES
- NDU/INSS
- DIA/TWP
- DIA/CMO
- NGIC
- 497th IG/INT

The meetings of the PPATS Users Group were held periodically from 03 April 1995 until 28 January 1997.

The first meeting was held 03 April 1995.
The meeting featured a review of program strategy for PPATS and the functions of the Users Group.

The second meeting was held 23 May 1995.
The meeting featured a briefing on the SRD and CONOPS document.

The third meeting was held 27 June 1995.
The meeting featured a briefing on the FDD.

The fourth meeting was held 29 August 1995.
The meeting featured a review of user comments on the SRD, CONOPS, and FDD.

The fifth meeting was held 26 September 1995.
The meeting featured the first technical demonstration of the PPATS software.

The sixth meeting was held 30 January 1996.
The meeting featured a technical demonstration of the nuclear model Alpha Release 1 PPATS software.

The seventh meeting was held 18 June 1996.
The meeting featured a technical demonstration of the chemical model using Alpha Release 2 PPATS software.

The eighth meeting was held 13 November 1996.
The meeting featured a program review, an overview of the PPATS Beta Test, and a technical demonstration of the chemical model using the Beta Test version of PPATS software.

The ninth meeting was held 28 January 1997.
The meeting featured an overview of PPATS Beta Test, feedback from USCENTCOM on their beta testing, and update on activities at DIA, and a technical demonstration of Temporal Findings as implemented in the PPATS software.

7.3 SITE VISITS/TECHNICAL FORA.

Demonstrations of the PPATS prototype software have been presented at numerous locations in addition to those held at the Users Group Meetings. Specifically:

• DSWA	22 Oct 1995
• USCENTCOM	01 Feb 1996
• USSOCOM	02 Feb 1996
• OSD(A)/SAC&C	29 Feb 1996
• LLNL	14 Mar 1996
• ATSD/AE (NCB)	27 Mar 1996
• CP Tools Conference	02 - 03 Apr 1996
• Monterey (MIIS)	04 Apr 1996
• NBC Conference	30 Apr -02 May 1996
• DISA/JIEO	26 Jul 1996
• USEUCOM	19 Feb 1997

7.4 BETA TESTING.

The Beta Test of the PPATS prototype was a key element in coordinating the software development program with the intended users. The independent assessment and beta testing of prototype software provided constructive input from the intended users. The principle focus of the Beta Test was the evaluation of the prototype software.

7.4.1 Beta Testing at USCENTCOM.

At USCENTCOM, the Beta Test used a locally generated data set reflecting the specific interest of the command. The test was set up to require only 40 total hours of personnel time and 20 hours of system support time. Structured

procedures were provided for the test personnel to follow after a minimum of spin-up training with allowance for unstructured evaluation (free-play). Suggested enhancements and necessary changes were to be documented as operator feedback to PPATS software developers.

General evaluation criteria were provided for use in scoring the prototype software. The criteria address four broad requirements for PPATS as summarized from the SRD: general requirements, input requirements, core requirements, and output requirements. The criteria were expressed as a collection of questions to be answered by the test personnel after they finished the beta testing.

In essence, the Beta Test conducted by USCENTCOM personnel was the first evaluation of the IOC version of the software. The version of prototype software used in the Beta Test has all the IOC functionality, except for the initial feasibility version of the biological model and the hazard potential attribute.

The feedback from USCENTCOM indicated a refined PPATS will benefit military analysts at warfighting commands if it has a current (maintained) sanctioned file, is resident on the SCI LAN, handles all source traffic in near-real-time, and provides for all WMD disciplines, including missiles. (Note: these issues are not limited by software development but, rather, are operational concepts in concert with the planned deployment of PPATS.)

7.4.2 Beta Testing at DIA.

DIA participated as a joint sponsor of PPATS with management and analyst involvement from the beginning of the prototype development in January 1995. DIA personnel participated in the PPATS Users Group meetings, accompanied DSWA on visits to the combatant commands and the national laboratories, coordinated and assisted in the case studies, and conducted an evaluation of the beta version of the prototype software. Throughout the development of PPATS, DIA management supported the endeavor to examine the potential utility of this new approach for processing intelligence information in support of counterproliferation analysis. Unfortunately, the availability for the country analysts to interact with the development of PPATS was extremely limited.

The evaluation of the beta version of the PPATS prototype software by DIA was accomplished in several sessions spanning January and February 1997. In all, three country analysts spent about sixteen hours training on, and evaluating the nuclear model, while two other analysts spent almost eight hours training on, and evaluating the chemical model for a total of 24 hours. In addition, a manager and two analysts had previously spent an hour reviewing the "alpha"

version software and how it was being used to carry out the nuclear case study.

DIA charged their analysts to evaluate PPATS in several areas: its ease of use/user interface; the intelligence analysis tasks it can perform; how well PPATS inputs data; how PPATS contributes to the analysis and understanding; and, the utility of PPATS outputs. The analysts were provided a users guide for the beta testing of the prototype software and CONOPS for the intelligence analyst as reference documentation supporting their evaluation tasking. The user guide provided a general explanation of the actions needed to carry out the beta testing of PPATS. The analyst's CONOPS document outlined the current view of how PPATS would function as a primary application for the DIA country analysts. The users guide has evolved into the Software User Manual (SUM) and the analysts CONOPS is an appendix to the CONOPS for the PPATS document.

DIA reported the conclusions of their evaluation of the PPATS software to DSWA in March 1997. Their conclusion was "PPATS software will not enhance the production of counterproliferation intelligence." Expanding on this, DIA summarized their evaluation criteria as threefold for the analysts: accuracy of results generated by software and model; contribution to performing intelligence tasks and to producing intelligence; and ease of use of software and loading and evaluating intelligence information. Additionally, from a software development perspective, they considered PPATS adaptability to use in the defense intelligence environment, technical compliance, supportability, and functionality.

In the case of the first analyst's criterion (accuracy of results), DIA found the prototype software to be too technically complex, requiring expert knowledge to employ (with the corollary of potential misuse or oversimplification by the novice who may fail to recognize the important subtleties involved) all its functionality. Even then, it was noted that the queries needed to resort to more complex Boolean constructs than those currently existing in the prototype software. In addition, the analysts indicated the capability to make impromptu changes in the pathways to cover newly discovered or suspected processes would be useful.

As for the second criterion (contribution to tasks), DIA analysts failed to see how the path analysis functionality could provide any "unique" insight into identifying critical nodes or paths. Even though the software is in the ACTD beta version of its prototype stage, the analysts clearly expected to have in place functionalities which are either planned enhancements or more reasonably provided by other applications co-resident with PPATS on an

integrated workstation. Such applications as imagery handling, cartographic functions, and desk top publishing for report preparation were never intended to be part of PPATS.

On the last analyst's criterion (ease of use), DIA summarizes their view as PPATS being overly labor intensive with little value added. Specifically, they believe PPATS would add at least another hour to every analyst's day, which would detract from other intelligence processes. Even though one analyst found the software easy to use, no one was ready to use PPATS in lieu of what is being done currently to read incoming message traffic. In sum, PPATS was not considered to be an acceptable tool for replacing the current procedures employed in retrieving, processing, organizing, and analyzing the incoming intelligence.

With respect to the technical criterion for the software, DIA noted PPATS is not compliant with present DoD and Intelligence Community technical policies. This situation was known to DSWA and reflects the implicit condition for the rapid prototyping approach to software development intentionally chosen for PPATS. Compliance to DoD and DIA technical policies were planned to be accomplished during the continued development of the software prototype.

In subsequent discussions regarding their evaluation of PPATS, DIA underlined their principle objection to the prototype software as, "This is not how we do intelligence." DIA described their normal operational procedure as one, which provides finished intelligence tailored to the customer's request for information. Most often, specific products are generated and provided to customers to respond to direct questions on counterproliferation topics.

DIA characterized its support to decision-makers as a carefully considered and focused summary of the top issues at hand. For instance, DIA would not normally provide any more technical detail regarding the acquisition of a nuclear weapon capability than basic statements (regarding current status and/or future estimates) on the major steps involved: source materials (mining, milling, and uranium conversion); enrichment of uranium; plutonium acquisition (reactor fuel fabrication, reactor operation, and spent fuel reprocessing); weapons technology (electronics, high explosive (HE) production, HE testing and weapon design); and parts assembly all leading to an operational capability.

DIA recognizes the combatant commands want proliferation path analysis used to help them prioritize potential counterproliferation targets for interdiction by military (and other) means. DIA does not expect the commands to do any path analysis. Path analysis (or nodal analysis) is being done by the individual

analysts as they review, organize, and analyze the intelligence input received by DIA. When a command issues a request for information, the analyst responds by drawing on his/her expertise and prepares an appropriate product with the required information which is then provided to the customer.

DIA simply does not recognize the PPATS prototype as a tool which can be effective in its day to day operations. Their evaluation, admittedly, did not include a direct and extensive assessment of the prototype software's capability to manage their incoming message traffic. However, they are considering the use of the Cameo functionality in Pathfinder to better manage their incoming intelligence. Cameo is a domain independent tool which allows the user to manually construct a hierarchical set of linked nodes. It does not have all the functionality provided by PPATS and will have to be created manually by an analyst for each country scenario of concern. Moreover, DIA has requested the PPATS lexicon set for use in the construction of the Cameo layouts.

7.5 DEFENSE EVALUATION SUPPORT AGENCY (DESA) ASSESSMENT.

The Deputy Assistant to the Secretary of Defense for Counterproliferation (DATSD(CP)) asked the DESA to perform an independent and impartial assessment of the PPATS program and program direction. In the course of that assessment, personnel evaluated both the documentation and the operational software. DESA interviewed key user organizations (DIA, USCENTCOM, JWAC, and CIA), gained an understanding of system operation and function through hands-on experience with the software, and reviewed documentation of other intelligence efforts.

7.5.1 Assessment of Operational Requirements for Path Analysis.

DESA found that the CP community has identified the need for a proliferation pathway analysis tool. Currently, they believe PPATS appears to be the only path analysis software program development which provides the capability to track each of the nuclear, biological, and chemical disciplines. Their assessment found two significant pieces of information in the WMD proliferation process were provided by the core functionality of PPATS. The first was a display of the path assessed to be closest to delivering a functional NBC weapon system. The second was the specific assessment of the state of development or readiness at each node in the process flow model. DESA also considers PPATS as a logical adjunct to the international link analysis efforts of the CIA.

7.5.2 Assessment of Software Capabilities.

In reviewing the prototype software, DESA found no other programs which duplicate the PPATS capabilities. Specifically, DESA stated:

> "The PPATS provides the only path analysis tool that addresses WMD proliferation areas for the US Government. It would standardize many of the current functions in the WMD proliferation intelligence community by providing a common analysis methodology and reporting format. The ability to share analyses, while providing the background data used to assign specific attributes to pathway events, would reduce duplicative efforts at various echelons and agencies. The PPATS capability to sift through large sets of message traffic, and select and assign traffic to specific process steps enables segmenting and logical ordering of the analysis process. The PPATS also could be used as an automated alarm for WMD proliferation activities in countries other than the core countries actively tracked by the DIA."

DESA views the strength of PPATS as its visual display of proliferation path analysis and its ability to link its graphic path analysis to underlying message and intelligence traffic.

7.5.3 Assessment of Deployment Concept.

DESA observed the current deployment concept requires an executive agency to create a sanctioned file and make it available to any intelligence agency with the PPATS software. As such, the introduction of PPATS would require increased manpower at the executive agency to generate the first set of sanctioned files (one per WMD discipline per country). Even so, DESA postulated as the software is adopted into the intelligence community, path analysis expertise should rise and the manpower support required by PPATS should decrease. However, DESA noted no organization has signed up to fill the executive agency role for PPATS.

7.5.4 Conclusions of DESA Assessment.

DESA determined the key issue for the PPATS program is that it does not have an explicit agreement with an executive agency to provide the necessary resources to support the fielding of the software application. However, that issue was separate from the capabilities of the prototype software and the status of the program development. Specifically, DESA stated:

> "The PPATS is a promising development that will provide a unique and needed capability to the CP intelligence community. The PPATS as a software system appears to be progressing well in its development cycle. There do not appear to be any significant technical design obstacles to achieve IOC. The PPATS path modeling methodology may expand to other areas of interest, such as terrorism, etc. The PPATS program represents a significant effort toward the establishment of a general 'path analysis' capability -- a capability which could eventually be applied to many other functions besides counterproliferation."

DESA pointed out how operational requirements seem to be somewhat unfocused. There does not appear to be a single integrated national counterproliferation community plan that describes the responsibilities and authority for its members with respect to evaluating related intelligence, performing technical assessments of the state of proliferation, nominating and prioritizing WMD production targets. Consequently, DESA recommended continued funding of the PPATS program only if the operational requirements for path analysis at each echelon are clearly defined, and if DIA agrees to support the program as the executive agency.

7.5 DSWA VIEWPOINT.

DSWA supports the entire CP community from the intelligence analyst to the decision-maker and the warfighter. From this viewpoint, the PPATS program is right on target. A valid requirement, even if not formally defined in detail at each echelon, exists for counterproliferation path analysis. The need for counterproliferation analysis was pointed out in the original (May 1994) DoD Report on Nonproliferation and Counterproliferation Activities and Programs commonly referred to as the "Deutch Report." In 1995 the PPATS program was specifically cited in the updated version (May 1995) of the same report. These references to the need for PPATS were further endorsed in 1996 by USEUCOM, USCENTCOM, and USSOCOM.

Most recently, proliferation path analysis was confirmed as one of the top ten prioritized counterproliferation enabling capability requirements in the 1996 Office of the Joint Chiefs of Staff (OJCS) report "Geographic Combatant Command Counterproliferation Prioritized Capability Requirements" (classified). This report is the result of a series of Counterproliferation Operational Planning Workshops (OPW) sessions conducted by the Deputy for Counterproliferation, Joint Warfighting Capability Assessments (D/CP JWCA) with each of the geographical commands. It was conducted in support of the

Joint Requirements Oversight Council (JROC) in their oversight of the DoD Counterproliferation Programs.

PPATS is designed to meet the need for counterproliferation analysis. It provides its users with a common framework for that analysis across three technical disciplines: nuclear, chemical, and biological proliferation pathways. The core functionality of PPATS is the path analysis of WMD acquisition programs being pursued by various countries or actors. The PPATS software allows its users to collect evidence of activity at process steps, associate active process steps with installations/facilities, determine critical paths based on findings of activity underway, and assess the impact of potential options imposed against the proliferant country or actor.

The CP community has witnessed the development of PPATS through the Users Group and numerous technical demonstrations of the evolving software. As noted above, USCENTCOM conducted a very productive and successful Beta Test of the prototype software. The technical merit of PPATS was a key measure involved in the independent and impartial assessment conducted for OSD by DESA. Their assessment is a clear endorsement of the technical approach employed in the PPATS development program.

DIA does not see PPATS as an acceptable tool for replacing the current procedures employed in conducting its counterproliferation analysis functions. DSWA considers this view shortsighted. The integration of PPATS into the daily routine of intelligence analysts at DIA can be managed to minimize the manpower drain. Admittedly, it will be a paradigm shift for DIA country analysts, but the changeover does not have to be immediate and disruptive. Properly applied, PPATS could replace current procedures used by analysts to track and monitor proliferant countries.

Even so, it is clear PPATS needs sponsorship in the intelligence community. Without some intelligence organization responsible for establishing and maintaining "sanctioned" country files, PPATS will be relegated to a training tool for counterproliferation analysts. DSWA believes the intelligence community must address the following issue now. If a full-fledged PPATS capability is not fielded, the bottom line question for the customers of counterproliferation analysis is:

How is the requirement for proliferation path analysis going to be met?

SECTION 8
CONCLUSIONS

DSWA began the development of PPATS to provide a common framework for conducting counterproliferation analysis. T he PPATS Program is based on a rapid prototyping approach geared to providing intended users an early opportunity to guide the evolution of the prototype software toward a more useful product. A PPATS Users Group was established as a first order of business and became a sounding board for setting requirements, developing the CONOPS, and defining the functional design for the software.

The approach employed in the development of PPATS was to integrate, incorporate, or interface existing tools and data sources in a common, integrated workstation environment where users may access, directly or indirectly, all the tools necessary to fulfill the NBC counterproliferation mission. Several aspects of the functional design required close coordination with subject matter experts and consensus from the PPATS user community.

PPATS is still in its initial three-year prototyping phase of software development begun in January 1995. The design and development of the PPATS core functionality occurred incrementally. Functionality was added and modified according to feedback from user involvement in the development of PPATS. Recently, USCENTCOM personnel conducted, with DSWA assistance, a very productive and successful beta test of the prototype software. Changes and enhancements to PPATS were made based on inputs from the beta testing at USCENTCOM. Likewise, the case studies and beta testing at DIA have led to changes in the software.

The CP community has identified the need for a proliferation pathway analysis tool. The independent evaluation of PPATS by DESA contends the path analysis tool will provide a unique and needed capability to the CP intelligence community. DESA rates PPATS as a software system which appears to be progressing well in its development cycle with no significant technical design obstacles in the way of achieving IOC.

On the other hand, DIA believes PPATS will not enhance the production of counterproliferation intelligence. While DIA recognizes the combatant CINCs want proliferation path analysis used to help them prioritize potential counterproliferation targets, the Agency believes such analysis should be done by the individual analysts as they review, organize, and analyze the intelligence input received. DIA will respond to any request for information, by preparing an appropriate product with the required information, which will then be

provided to the customer. In this context, PPATS appears to DIA as only an additional manpower burden with little payoff for the intelligence analyst.

However, DSWA supports the entire CP community from the intelligence analyst to the decision-maker and the warfighter. From this viewpoint, the PPATS program is right on target. A valid requirement, even if not formally defined in detail at each echelon, exists for counterproliferation path analysis. The integration of PPATS into the daily routine of intelligence analysts at DIA can be managed to minimize the manpower drain. Admittedly, it will be a paradigm shift for DIA country analysts but the changeover does not have to be immediate and disruptive. Properly applied, PPATS could replace current procedures used by analysts to track and monitor proliferant countries.

SECTION 9
RECOMMENDATIONS

By the end of this calendar year (December 1997), PPATS could increase its capability to serve as a counterproliferation analysis tool. It could be qualified to operate on SCI LAN's at the DIA and at selected Theater CINC locations. Additionally, it would have increased analytical and data feed functionality. Also, it could provide extensive documentation and training procedures to support the development of a core of knowledgeable users.

Specifically, PPATS software needs to be:

- Security accredited for SCI LAN operation with planned extension to provide WAN connectivity over Joint Deployable Intelligence Support System (JDISS) or other SCI linkages;
- Compliant with the Defense Information Infrastructure (DII) Common Operating Environment (COE) and the Joint Technical Architecture (JTA); and
- Verified and validated in terms of the nuclear, chemical, and biological models.

Moreover, PPATS functionality should be extended to include:

- Implementation of the Hazard Potential Attribute;
- Establishment of an expanded biological model;
- Connectivity to intelligence feeds such as SAFE, DAWS (possibly MIDB and MDITDS, if available); and
- Interfaces to IMEA and RAAP (given reciprocal actions).

PPATS documentation would include:

- Revised and updated program reports;
- Software Users Manual;
- Software Developers Manual;
- Quality Assurance/Configuration Management program reports;
- System level documentation; and
- User training procedures.

APPENDIX A
SELECTED BIBLIOGRAPHY

Chemical Weapons Capability Acquisition Process (CWCAP), User Manual, December 1993

Chemical Weapons Process Parameters, Volume 1-Main Report, DNA-TR-91-217-V1, November 1992

Chemical Weapons Process Parameters, Volume 3-Users' Guide, DNA-TR-91-217-V3, November 1992

Chemical Weapons Training Tool (CWTT), User Manual, May 1994

DODIIS Migration Systems Instructions to DExAs, PMOs, and Developers, April 1995

GCCS Common Operating Environment Baseline, November 28, 1994

IAEA Programme 93+2 Task 5, Improved Analysis of Information on States' Nuclear Activities, 23 February 1995

Nuclear, Biological & Chemical Target Dominant Source Knowledge Base Development, Volume 1-Design, DNA-TR-95-50-V1, April 1996

Nuclear, Biological & Chemical Target Dominant Source Knowledge Base Development, Volume 2-Appendix J - Programmer's Guide, DNA-TR-95-50-V2, April 1996

Nuclear Capabilities Acquisition Process (NCAP), User Manual, August 1994

Pathfinder, Version 8.0, User's Guide, 14 December 1995

Proliferation Modeling Focus Group of the Nonproliferation and Arms Control Technology Working Group, Final Report, 30 September 1996

Software Development and Documentation, MIL-STD-498, 5 December 1994

Standard Coding Systems Functional Classification Handbook, DIAM 65-3-1, July 1995

Technical Evaluation Report on Proliferation Capabilities Acquisition Process (CAP) Models, November 1, 1993

Technologies Underlying Weapons of Mass Destruction, OTA-BP-ISC-115, December 1993

APPENDIX B
ABBREVIATIONS AND ACRONYMS

ADP	Automated Data Processing
API	Application Program Interface
BCAM	Biotechnology Capabilities Acquisition Model
CONOPS	Concept of Operations
COTS	Commercial-off-the-Shelf
CP	Counterproliferation
CPRC	Counterproliferation Program Review Committee
CWCAP	Chemical Weapons Capability Acquisition Process
DESA	Defense Evaluation Support Agency
DIA	Defense Intelligence Agency
DNA	Defense Nuclear Agency
DoD	Department of Defense
DSWA	Defense Special Weapons Agency (formerly DNA)
EOC	Early Operational Capability
FDD	Functional Design Document
FOC	Full Operational Capability
GB	GigaBytes
GOTS	Government-off-the-Shelf
GUI	Graphical User Interface
IMEA	Integrated Munitions Effects Assessment
IOC	Initial Operational Capability
JDISS	Joint Deployable Intelligence Support System
JTF	Joint Task Force
LAN	Local Area Network
MB	MegaBytes
MDITDS	Defense Intelligence Threat Data Migration System
MIDB	Modernized Installation Data Base
NBC	Nuclear, Biological, or Chemical
NCAP	Nuclear Capabilities Acquisition Process
OSF	Open Software Foundation
PC	Personal Computer
PPATS	Proliferation Path Assessment and Targeting System

PPF	Process Parameter File
R&D	Research and Development
RAAP	Rapid Application of Air Power
RAM	Random Access Memory
SA	System Administrator
SCI	Special Compartmented Information
SRD	System Requirements Document
S&T	Science and Technology
SUM	Software Users Manual
TREM	Time Remaining
TTOC	Time to Completion
WMD	Weapons of Mass Destruction

APPENDIX C
GLOSSARY OF TERMS

AGGREGATE. The process of combining the element attribute values to provide values for higher level elements.

AND NODE. A location in the process network where two or more elements/actions are combined. All elements must be operational in order for the node to be operational.

ATTRIBUTE. One of the seven different characteristics of a process element. The values entered for each attribute are used in the aggregation process. Attributes are: Uniqueness, Step Intent, Time to Completion, Time Remaining, Susceptibility, Hazard Potential, and Throughput Capacity.

BOOLEAN LOGIC. Based on the idea that logical propositions are either true or false, depending on the type of operation they describe and on whether the variables involved are true or false, two important aspects of Boolean logic are that variables can be restricted to one of only two values, true or false, and relationships between these variables can be expressed logically with operators such as AND, OR, and NOT.

COUNTRY SCENARIO FILE. A file containing attribute values and reference data regarding the development of nuclear, biological, and chemical weapons by specific country.

ELEMENT. Any component in the template diagram. Items, nodes, and segments are all elements.

END POINT. Any point in the nuclear, biological, and chemical weapons process. Critical intent or time paths are calculated leading to the end point selected by the user.

FINDING. An excerpt of a document leading to the correlation between the query results and the observables/indicators.

HAZARD POTENTIAL. Represents a judgment of the likelihood for unwanted collateral effects if an item or segment is subjected to physical damage from a military attack.

ICON. Graphical representation of a process element or a running application.

INDICATOR. A singular identity with lexicon items (equipment, materials, or personnel).

ITEM. A basic, unexpandable activity or process in the template.

JUSTIFICATION TEXT. A short statement providing reasons for the assignment of an attribute's value.

LANDMARK. A short phrase that identifies an element. The phrase appears next to the element when displayed in the network.

LAYOUT. A visual display of the activities involved in the development of an nuclear, biological, and chemical weapons program.

LEXICON. Phrases made up of identifiers, keywords, and constants describing all elements in the process network.

MILESTONE. Any point in the nuclear, biological, and chemical weapons process. Critical intent or time paths are calculated leading to the milestone element selected by the user.

NETWORK. Graphical representation (in the form of pathways) of activities a country could follow in developing a nuclear, biological, or chemical weapons program.

NETWORK VIEW. A partial or full graphical representation of the network.

NODE. Location in the process network where two or more elements are combined.

OBSERVABLE. A process step-related statement of activities involving items taking place at certain locations.

OR NODE. A location in the process network where two or more elements/actions are combined. Only one has to be operational for the node to be operational.

PATH. A composite of two or more elements specifying a particular route for achieving some capability (intermediate or full).

PATHFINDER. A data retrieval and analysis application created by Presearch. This application will search a database of text documents based on specific criteria and extract the matching documents.

QUERY. The process of extracting data from a database and presenting it for use. A query is a collection of related topics or concepts used to extract specific data from a large database of information.

SCENARIO FILE. See Country Scenario File.

SEGMENT. A related group of two or more elements.

SEQUENCE. A series of template process activities which must be completed in sequential order.

STEP INTENT. Represents a judgment on the likelihood that an item in a proliferation path is proceeding.

SUSCEPTIBILITY. Represents a judgment of the likelihood that an activity could be impeded, halted, or interdicted by any means such as political, economic, or military action.

TEMPLATE. The underlying structure of the complex activities making up a weapons program. Provides a comprehensive list of all required inputs for planning, production, and deployment of a weapons program.

TEMPLATE FILE. A file containing the list of all process items required for a capability and their logical relationships using AND nodes, OR nodes, and SEQuences.

THROUGHPUT CAPACITY. Estimated rate of nominal weapon material throughput for an item in a proliferation path.

TIME REMAINING. Estimated range of time for an activity to be completed.

TIME TO COMPLETION. Estimated time in months to proceed from start to finish to acquire an input or construct a facility.

UNIQUENESS. Represents a judgment about how specialized an item is to the accomplishment of the next segment or milestone.

ZOOM. The magnification or reduction in size of a defined area of the process network.

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